REMARKS

Reconsideration of the application, as amended, is respectfully requested.

In the Action, the Examiner rejects claims 1-2, 5-13 and 18-19 under 35 U.S.C. §103(a) as being unpatentable over EP 260,512 to Chang (Chang). The Examiner further rejects claims 3 and 14-16 under 35 U.S.C. § 103(a) as being unpatentable over Chang in view of US SIR No. H647 to Johnson et al. (Johnson et al.). Lastly, the Examiner rejects claims 4 and 17 under 35 U.S.C. § 103(a) as being unpatentable over Chang in view of EP 1 201 777 to Mourer et al. (Mourer et al.).

The above rejections are respectfully disagreed with, and are traversed below.

Independent claim 1 has been clarified to specify a method for determining a heat treatment temperature with minimal superheat and reducing residual stress of a nickel-base superalloy article comprising about 40-70% of gamma prime phase and having a gamma prime solvus temperature, comprising the steps of: a) providing a furnace; b) determining a specific furnace tolerance temperature for the nickel-base superalloy by placing thermocouples embedded with representative metal on different locations of the furnace and taking temperature readings from the thermocouples; c) super-solvus heat treating the superalloy article to only about the gamma prime solvus temperature plus only the furnace tolerance temperature of the superalloy; and d) holding at the super-solvus heat treatment temperature of b) for about 0.25-2 hours, wherein the heat treated superalloy article has reduced residual stress.

Claims 2-6, 8-13, 15-16 and 19 depend from claim 1 and recite further advantageous features of the claimed method. Claims 7, 14 and 17-18 have been canceled. New claim 20 has been added to specify: a method for determining a heat treatment temperature with minimal superheat and reducing residual stress of a nickel-base superalloy article comprising about 40-70% of gamma prime phase and having a gamma prime solvus temperature, consisting essentially of the steps of: a) providing a furnace; b) determining a specific furnace tolerance temperature for the nickel-base superalloy by placing thermocouples embedded with representative metal on different locations of the furnace and taking temperature readings from the thermocouples; c) super-solvus heat treating the superalloy article to only about the gamma prime solvus temperature plus only the furnace tolerance temperature; and d) holding at the super-solvus heat treatment temperature of b) for about 0.25-2 hours, and e) quenching the superalloy article, followed by subsolvus precipitation heat treatment, wherein the heat treated superalloy article has reduced residual stress and the superalloy article is a seal or a high pressure turbine disk made of Rene′88DT and the super-solvus heat treatment temperature is calculated to be about 2060-2070°F.

Support for the foregoing exists throughout the specification at, for example, page 6.

It is asserted that the cited references, whether viewed alone or in any combination, do not disclose or suggest the foregoing claimed invention for at least the following reasons.

The primary reference, Chang, generally discloses a combination of a solution anneal at a temperature above the gamma prime solvus temperature followed by a slow cooling rate (page 4). Chang does not disclose or suggest any method for determining a heat treatment with minimal superheat as claimed herein including, in part, determining a specific furnace tolerance temperature of a nickel-base superalloy by placing thermocouples embedded with representative metal on different locations of a furnace and taking temperature readings from the thermocouples. Nor does Chang disclose or suggest then super-solvus heat treating the superalloy article to only about the gamma prime solvus temperature plus only the furnace tolerance temperature of the superalloy; and holding at the super-solvus heat treatment temperature of b) for about 0.25-2 hours, wherein the heat treated superalloy article has reduced residual stress.

The addition of Johnson et al. and Mourer et al., alone or in combination, does not cure the shortcomings of Chang. In particular, the Johnson et al. reference relates to fabricating a disk by co-extrusion. In particular, this reference discloses the preparation of a cylindrical shaped preform billet having a central bore region and comprising a first material. The billet also has a rim region comprising a second material. The billet is extruded at a preselected extrusion temperature through a die to form an extrusion product of preselected reduction.

Mourer et al. disclose a particular superalloy composition optimized for high-temperature performance in turbine disks.

Neither Johnson et al. or Mourer et al. disclose or suggest any method for determining a heat treatment with minimal superheat as claimed herein including, in part, determining a specific furnace tolerance temperature of a nickel-base superalloy by placing thermocouples embedded with representative metal on different locations of a furnace and taking temperature readings from the thermocouples. Nor do these references disclose or suggest then super-solvus heat treating the superalloy article to only about the gamma prime solvus temperature plus only the furnace tolerance temperature of the superalloy; and holding at the super-solvus heat treatment temperature of b) for about 0.25-2 hours, wherein the heat treated superalloy article has reduced residual stress. One skilled in the art seeking to develop the claimed method would not even be motivated to look to these references, which are both concerned with unrelated problems, for guidance.

Moreover, the cited references do not provide any indication of the negative impact of heat withdrawal during quench from supersolvus temperature on the residual stress trapped within the component. Based on, e.g., Chang and Johnson et al., the only upper temperature limit for heat treatment is the melting temperature of the alloy. This causes difficulties due to the unexpected residual stresses that form and do not relax during, for example, a final age hardening at subsolvus temperatures well below solvus (e.g. 1400°F) as the material is now very creep resistant in the coarse grain condition.

Applicant has determined a supersolvus heat treatment as close to the solvus temperature as possible to minimize the amount of thermal energy that needs to be extracted during quench. The Examples set forth in the specification and modeling has shown the benefit of this minimal superheat on residual stress. Thus, the Examiner's attention is also directed to the Examples set forth at pages 7-9, which demonstrate the improved and unobvious results of Applicant's process.

Applicant respectfully asserts that independent claims 1 and 20 are in condition for allowance, and thus remaining dependent claims 2-6, 8-13, 15-16 and 19 are also allowable in view of their dependency from an allowable independent claim. Accordingly, a notice of allowance is respectfully requested.

Respectfully submitted,

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